



**Aerated lagoons**



**Wetland cells**



**Wetland trench – not yet planted**

| Bennett Facility Statistics |  |
|-----------------------------|--|
| Nearest Town:               | Bennett                                    |
| County:                     | Adams                                      |
| River Basin:                | Middle South Platte                        |
| Receiving Water Body:       | Unnamed drainage – tributary to Lost Creek |
| Year Operational:           | Pilot scale studies                        |
| Population:                 | 2200                                       |
| Elevation (feet):           | 5490                                       |
| Design Flow (mgd):          | 0.42                                       |
| Average Flow (mgd):         | 0.08                                       |
| Size (acres):               | 2  |

## Facility Description

The Bennett system is minor municipal aerated lagoon system. The facility consists of two aerated lagoons, one polishing pond, and a chlorine contact basin.

The permitted design capacity of the Bennett system is 0.42 million gallons per day for hydraulic flow (30-day average).

The Town is conducting a reuse pilot study using the facility effluent in constructed wetlands. These studies include the use of solar powered motors and pumps, and aerators. An ion generator is being used to kill both bacteria and algae. Independent testing and subsequent trials indicate that ion generator disinfection method will meet CDPHE requirements. Bennett plans to reuse its effluent by supporting a retail nursery, irrigation for parks and a ball field, and the incorporation of hot houses for commercial crops.

## **Background Information**

On July 29, 1993 the Town of Bennett was issued a Notice of Violation and Cease and Desist Order for exceeding permitted BOD5 effluent limits. The plant was originally designed to operate as a three-pond system. This proved to be too expensive to operate and the plant was cut back to one pond. Pond 1 was curtailed off to provide a primary pond, with floating aerators, a secondary pond with floating aerators, and a covered polishing pond. Design based on population growth that did not occur. The main problem has been abnormally heavy algae growth.

The town is conducting a reuse pilot study using constructed wetlands. At this time, the wetlands are not a part of the treatment process.

The facility consists of a three-cell lagoon system: cell 1 is operated as a complete mix lagoon, cell 2 is operated as a partial mix lagoon, and cell3 functions as a polishing pond, and a chlorine contact basin.

## **Energy Analysis:**

The site uses 4 – 7.5 hp aerators running full-time. This results in an annual energy consumption of 196,000 kw/year. The Town is currently experimenting with low energy processes to reduce the energy consumption. These processes include solar-powered aerators, and ion-generators to assist with disinfection.

## **Construction Cost**

The Town of Bennett was able to retrofit existing ponds with minimal construction. One of the original lagoons was converted to a wetland area. Earthwork was provided to divide the lagoon into 4 connected cells. It was estimated that the cost to implement the wetland was around \$150,000.

## **Design**

### **Design Methods**

The Bennett wetlands were designed to fit into the existing site. An abandoned lagoon was retrofit to incorporate the subsurface portion of the wetland. A ditch along the perimeter of the site serves as a subsurface wetland.

### **Objectives**

The Bennett wastewater treatment plant is has been updated in recent years to consistently meet effluent permit requirements. The implementation of the wetland cells have the primary goal of further cleansing the water, providing wetland plants for reuse and experimental area for testing low energy treatment methods.

### **Size**

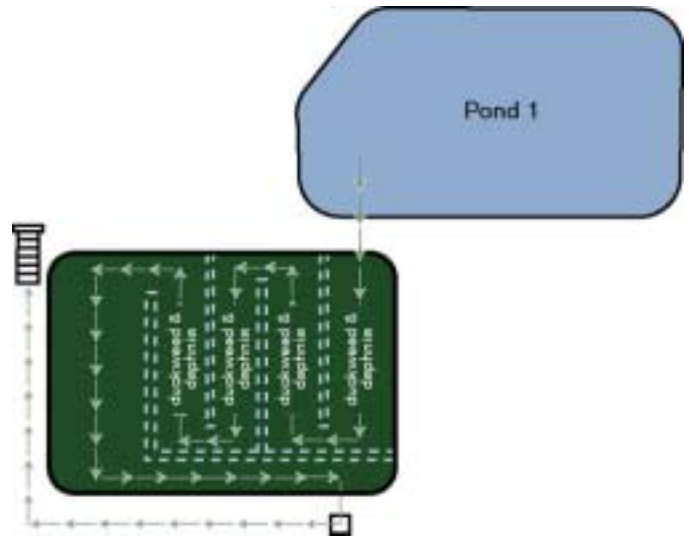
An existing lagoon has been retrofit to include a constructed wetland system. The lagoon is approximately 1.8 acres. A cattail and gravel trench has been constructed to transport the effluent from the wetland system to the chlorine contact basin. This trench is approximately 20 feet wide and approximately 700 feet long.

## Shape

Berms have been constructed to divide the lagoon into five cells that are connected by a serpentine flow path. The cattail and gravel trench that runs along the perimeter of the FWS wetland cells is designed as a subsurface component of this system.

## Hydraulics

The wetland system has been designed to include operating flexibility. Splitter boxes are provided to allow the bypass of the wetland system. The first portion of the wetland receives flow by gravity from the lagoon system. The inlet pipe from the splitter box discharges directly into the wetland. After winding through the serpentine wetland system, flow collects at a holding cell along the western side of the wetland. A pump is used to lift the water to the gravel and cattail trench. The water flows by gravity in this trench along the perimeter of the wetland cells. At the end of the trench, the flow can be directed into a greenhouse or directly into the chlorine contact chamber.



## Water Quality Data

At the time of this study, the Bennett system was not a component of the permitted treatment facility. No monthly discharge testing records are available for this wetland system.

## General Ecological Setting

The four Bennett constructed wetland cells are flat and rectangular. Three of the cells have an area of approximately 0.10 acre each, and cell 4 is approximately 0.20 acre. The wetland currently is not discharging. The Bennett treatment wetland is located in an upland agricultural area on the north side of the Town of Bennett.

## Cell Vegetation

Each cell at the Bennett site has a slightly different vegetation composition, and a different ratio of vegetation to water. Cell 1 is composed of 98 percent water and 2 percent vegetation. Two vegetation communities are present in cell 1. Vegetation community 1, which comprises 60 percent of cell vegetation, is dominated by cattail (*Typha latifolia*) and softstem bulrush (*Scirpus tabernamontanae*). The remaining 40 percent is composed of barnyard grass (*Echinochloa crus-galli*), curly dock (*Rumex crispus*) and pinkweed (*Polygonum pensylvanica*). Cell 2 is 3 percent open water and 97 percent vegetated. There is a single plant community, which is dominated by duckweed (*Lemna minor*), cattail, and softstem bulrush. Cell 3 is similar to cell 2 and has the same vegetation-to-water ratio. Vegetation community 1, which comprises 65 percent of cell vegetation, is dominated by cattail and softstem bulrush. The remaining 35 percent is composed of pinkweed, barnyard grass, and curly dock. Cell 4, which is twice the size of cells 1, 2, and 3, is 97 percent vegetation and 3 percent water. It has a single vegetation community, which is dominated by duckweed, cattail, and softstem bulrush.

## Planting/Seeding

In the Spring of 1999 seedlings were planted. No surface mulch was added. Duckweed and Daphnia were introduced to the system 3 to 4 years ago.

## Weeds

No noxious weeds were found on the site.

## Maintenance Issues

A portion of the Bennett system will serve as a nursery for wetland plants. This area will be harvested as needed.

## Wildlife

The Bennett wetland provides habitat for red winged black birds and waterfowl. Red winged black birds were observed during the site visit. The wetland has some structural diversity because it contains both shallow water and areas of emergent vegetation. However, its value is limited because only a small portion of the wetland is vegetated; open water comprises most of the wetland cells.

## Wetland Biodiversity Functional Assessment

Sediment/nutrient/toxicant removal rated high. General wildlife habitat and production export/food chain support rated moderate. Habitat diversity and uniqueness of the constructed wetland rated moderate to low. This wetland received 43 percent of the total possible functional points, and was classified as a category III wetland.

| Wetland Biodiversity Functional Assessment. |                                 |                 |
|---|---------------------------------|-----------------|
| Function and Value Variables                | Functional Points<br>(0.1 to 1) | Possible Points |
| General Wildlife Habitat                    | 0.5 (mod.)                      | 1               |
| General Fish/Aquatic Habitat                | 0.0                             | 1               |
| Production Export/Food Chain Support        | 0.7 (mod.)                      | 1               |
| Habitat Diversity                           | 0.2 (low)                       | 1               |
| Uniqueness                                  | 0.2 (low)                       | 1               |
| Total Points                                | 2.6 (52%)                       | 5               |
| Wetland Category (I, II, III, or IV)        | III                             |                 |

## Human Use

The wastewater wetland is part of a restricted public access area. This wetland has low to moderate aesthetic value because it is dominated mainly by open water. This facility has been included in a 'smart growth' study being conducted by the OEMC due to the alternative energy methods being.

## **Overall Site Comments**

At the time of the site visit, the wetland was still being constructed. The use of a both surface and subsurface flow wetland components is a unique treatment design.